FOREST PEST MANAGEMENT
Pacific Southwest Region

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SOIL MONITORING FOR PHYTOPHTHORA LATERALIS AT CEDAR RUSTIC CAMPGROUND, GASQUET RANGER DISTRICT, SIX RIVERS NATIONAL FOREST

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ABSTRACT

All Port-Orford-cedars were removed from Cedar Rustic Campground in 1986 and soils from six selected sites within the area were monitored for Phytophthora lateralis. The pathogen was not detectable after two months at several sites, after 18 months at two other sites, and after 36 months at the remaining two sites. After the 3 years, 27 additional sites were sampled using Port-Orford-cedar seedlings as bait. The fungus was recovered from seedling roots in soil from one site, but was not recovered one year later.

BACKGROUND

Port-Orford-cedar root disease, caused by the fungus Phytophthora lateralis, has been present in the Smith River drainage for a number of years and is spreading to previously uninfested areas within the drainage. Infested areas can be a source of inoculum for spread of the disease, either in drainage water or by movement of infested soil. Once a site is infested, a means of eliminating the pathogen is to eliminate the host from the site for a period of years. Although the length of time is not known, a minimum of three to five years has been suggested as the interval needed before the fungus dies out in the absence of the host (Roth, et. al., 1987). The Gasquet Ranger District, Six Rivers National Forest, as part of a program to reduce Port-Orford-cedar root disease impact, requested Forest Pest Management assistance in monitoring an area (Cedar Rustic Campground) for presence of Phytophthora lateralis after host removal. The objective was to determine if removal of Port-Orford-cedars from the campground would eliminate Phytophthora lateralis from the soil, thus eliminating the area as a source of inoculum for transport of Port-Orford-cedar root disease to uninfested areas.

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The 5-to 6-acre campground is located adjacent to highway 199 on the Middle Fork of the Smith River (Figure 1). Vegetative cover is predominantly Douglas-fir, tan-oak, and alder, with some big leaf maple, bay, dogwood and redwood. Port-Orford-cedar was part of the vegetation, and was salvaged periodically since the early 1980s because of infection by P. lateralis.

PROCEDURE

In the summer of 1986, all Port-Orford-cedars from the Campground and immediately surrounding area were removed (120 trees via a timber sale; remaining seedlings and saplings removed by the District using K-V funds). Logging and slash clean-up was completed September 30, 1986, and slash burning was done in October. Cutting and disposal of saplings and other Port-Orford-cedar regeneration was completed by January 1, 1987.

Monitoring for P. lateralis in the soil was done as follows:

1) Six sites were selected in the campground in July, 1986 prior to tree removal. Each location consisted of a Port-Orford-cedar -- pole-sized or larger, that was actively dying from root disease -- as its center and an approximately 8 foot radius circle around the tree. The locations were chosen away from the highway, campground roads, streams, and drainage water to reduce the risk of outside infestation after the study began (Fig. 1).

2) Initial soil sampling occurred in January, 1987 after all salvage and clean-up work was completed. Subsequent sampling was planned to occur three times yearly for 3 to 5 years. It was anticipated that soil samples would be collected about 3 times a year from each of the six sites a) after the first heavy rain in the fall (October), b) in early spring (March), and c) mid-summer (July) when the soils are driest. If the fungus was recovered from the soil 5 years after host removal (1991), a decision was to be made then if soil monitoring should continue. If the fungus was not recovered after a period less than 5 years, monitoring was to continue for one more year.

3) At each site, about 1/2 to 3/4 quart of soil (2 scoops from a hand trowel) was collected from the upper 8 inches of soil (after removal of loose surface duff) at each of three points (about 90 degrees apart) about 8 feet from the base (stump) of each tree. The exact point was determined in the field to avoid trails and compacted soils. The three soil samples (6 scoops total) were combined into one plastic bag, labeled with location number, and sent to Forest Pest Management. The trowel used to collect samples was cleaned of all soil between locations. Each of the 3 points was marked with a stake at the time of initial sampling. Subsequent samples were taken from approximately the same points.

4) Port-Orford-cedar foliage to be used as baits (see below) was collected from other locations on the Gasquet Ranger District, placed in plastic bags, and shipped to Forest Pest Management with the soil samples.

5) Soil from each of the six sites was wet-sieved in the laboratory to concentrate the organic matter fraction (Ostrofsky et. al., 1977). Five grams of organic matter were placed in each of 10 double cups (replicates) (Linderman and Zeitoun, 1977) and baited with 5 Port-Orford-cedar branchlet sections (3-4 cm long, cut from distal 20 cm sections of succulent branches; foliage removed) over water containing 25 ug/ml hymexazol (Hamm and Hansen, 1984). After 6 days, baits were removed, placed (5 baits/plate) on 1/2 strength corn meal agar (10 g/l) with 5 ug/ml pimaracin, 250 ug/ml ampicillin and 10 ug/ml rifamycin (Hamm, personal communication), and observed for colony growth of P. lateralis.

Because the fungus was not recovered in the winter or spring of 1990, a second method of determining the presence or absence of the fungus at the site was begun in April, 1990. Port-Orford-cedar seedlings were used as bait. A total of 33 Port-Orford-cedar stumps (6 marked for the soil baiting study, plus an additional 27) were located at the campground. At each stump, soil was collected at three points (about 8 feet from the stump and 90 degrees apart), placed in a one gallon black plastic pot, and a Port-Orford-cedar seedling (1-0, Humboldt Nursery) placed in each pot. The 99 pots (3 from each of 33 stumps) were taken to the Gasquet Ranger District office grounds and observed for symptom development. When symptoms did develop the seedlings were shipped to the FPM lab in San Fransciso to determine if P. lateralis was present. Roots were placed on corn meal agar with pimaricin.

Because of the need to avoid contamination of sampling points from outside sources, rehabilitation of the campground (chips at pads, etc.) was postponed until completion of the monitoring study. The campground was closed to the public. The entrance was gated and signs were posted to explain the reason for the closure.

RESULTS

Soil Baiting at Six Sites

Soil samples were taken at 12 time periods between January 1987 and April 1991. There was a high degree of variability in recovery of P. lateralis among the six sites (Table 1). The fungus was not recovered after 2 months on sites 4 and 5, after 18 months on sites 1 and 2, and after 36 months on sites 3 and 6. Samples were not taken during several periods, for example, the fall of 1987 and the fall of 1989, because of dry soil conditions. The pathogen was not recovered at any of the sites in July and November, 1988. The soils were very dry during that period, with little or no rain occurring at the campground. The last samples were collected 58 months after removal of the host.

Table 1. Results of soil baiting from Cedar Rustic Campground, Six Rivers National Forest.

Date	Location 1	2	3	4	5	6
January, 1987	+[1]	+	+	+	+	+
March, 1987	0	0	+	0	0	+
July, 1987	0	+	+	0	0	0
March, 1988	+	+	+	0	0	+
July, 1988	0	0	0	0	0	0
November, 1988	0	0	0	0	0	0
April, 1989	0	0	+	0	0	+
August, 1989	0	0	+	0	0	+
January, 1990	0	0	0	0	0	0
March, 1990	0	0	0	0	0	0
April, 1990	0	0	0	0	0	0
April, 1991	0	0	0	0	0	0

[1] + = lateralis recovered; 0 = lateralis not recovered; each entry represents 50 pieces of Port-Orford-cedar foliage, 5 in each of 10 cups

Potted Seedlings

When potted Port-Orford-cedar seedlings were used as bait in soil collected in April, 1990, 10 of the 99 seedlings died (9A, 9C, 10A, 11A, 13A, 17C, 19C, 22B, 24A, 24B) over a 9 month period. P. lateralis was recovered from one seedling (11A). In April, 1991, soils were collected from 3 points around each of stumps 10, 11, and 13 and baited with Port-Orford-cedar foliage in double cups. Soil was also collected from around the original 6 stumps and baited. Phytophthora lateralis was not recovered.

DISCUSSION

At the six sites sampled at Cedar Rustic Campground, the fungus was not detected by the double cup method from soil samples collected three years after host removal. Additional sampling, using Port-Orford-cedar seedlings as bait, at 27 other sites within the campground found the fungus at one site after the three years. Further sampling at 9 sites one year later (4 years since the host was removed) was negative. Although additional sampling may result in recovery of the fungus, in the sites we sampled the fungus was undetectable. Indications are that, for that area, under those soil conditions, and with the techniques used, populations of P. lateralis decreased to undetectable levels 3 to 4 years after host removal. This time period would vary with conditions. However, results suggest that the removal of Port-Orford-cedar from an area to

eliminate the pathogen is a reasonable management alternative in some areas to slow the spread of the disease.

In April, 1991, the campground contained undetectable levels of P. lateralis. The campground is currently a very low risk as a source of inoculum for spread of the disease. If Port-Orford-cedar were re-introduced into the area, or if natural regeneration of Port-Orford-cedar were allowed to occur, the fungus would probably re-infest the area because of the campground's high use and its proximity to a major highway. If Port-Orford-cedar were kept out of the area, and replaced with a non-host, the area would remain free of inoculum.

LITERATURE CITED

Hamm, P.B., and E.M. Hansen. 1984. Improved method for isolating Phytophthora lateralis from soil. Plant Disease 68:517-519.

Linderman, R. G., and F. Zeitoun. 1977. Phytophthora cinnamomi causing root rot and wilt of nursery-grown native western azalea and salal. Plant Dis. Rep. 61:1045-1048.

Ostrofsky, W.D., R.G. Pratt, and L.F. Roth. 1977. Detection of Phytophthora lateralis in soil organic matter and factors that affect its survival. Phytopathology 67:79-84.

Roth, L.F., R.D. Harvey, Jr., and J.T. Kliejunas. 1987. Port-Orford-Cedar Root Disease. USDA Forest Service, Pacific Northwest Region, R6 FPM-PR-294-87. 11 p.

Cedar Rustic Campground

● = location of sampling sites

T17N.

SALE AREA MAP

SALE NAME:Rustic Cedar Salvage (SSTS)
ANGER DISTRICT:Gasquet

SCALE

- Sale Area Boundry, Item 1
- Campground Road, Item 8
- U.S. Highway 199
- Campground Fence, Item 8
- Underground Pipeline, Item 8
- Water Standpipe & Faucet, Item 8
- Outhouse, Item 8
- Protected Stream, Item 11

VITY LEVEL APPLICABLE TO THIS SALE WILL
MODEL G AN WEATHER STATION SHIP MTN.

LAND LINES ARE APPROXIMATE

6/18/86